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AUTHOR Raat, Jan H.; de Vries, Marc
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ABSTRACT

The conception of and attitude toward technology of 13-year-old students was investigated. Twelve students were interviewed to find out what they thought of technology and how important it was to them. Other students (N=48) responded to 10 open-ended questions to determine their ideas about technology. Results were then used to construct a questionnaire consisting of 80 questions answered in a 5-point Likert scale format. The questionnaire was offered to some 3,000 13-year-old students of different types of schools in different parts of the Netherlands. The results were factor-analyzed. Twenty factors were found of which 14 could be identified. Factor scores were computed and the differences between girls and boys were tested for significance. Results show that: (1) students think that technology is a broad, important, and not too difficult subject, but it is hard for them to say what it is and why it is not the same as physics; (2) girls are less interested in technology than are boys; (3) girls as well as boys think that girls have the aptitude for technology; and (4) students with a technical father or mother are more acquainted with technology and are more aware of the importance of the field. (JN)

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WHAT DO 13-YEAR OLD PUPILS THINK ABOUT TECHNOLOGY

The concention of and the attitude towards technology of 13 year old girls and boys

Contents

Summary	1
1. Introduction	2
2. The attitude-measurement	2
3. Results	5
4. Conclusions	8
5. Further research and international cooperation	12
Literature	13
Annendix 1 Mean scores and standard deviations	14
Annendix 2 Factors and their items	21
Annendix 3 International cooperation	27

prof. dr. Jan H.Raat
drs. Marc de Vries

Eindhoven University of Technology
Postbox 513
5600 MB Eindhoven
The Netherlands

phone (0)40 473095
(0)40 474331

Summary

In The Netherlands as in many countries students have to make their first choises concerning study and future profession at an age of 13 to 15 years.
As for technology, the curriculum does not prepare pupils well in making these important choises. One can wonder if pupils at this age have knowledge enough to make decisions that can have so big consequenses. What do 13 year old pupils know about technology? What is their interest in it? From experience in the MENT-project as for the relation "girls and physics" we expect 13 year old girls to have less idea of what technology is than boys have and a less positive attitude towards technology.
To test these hypotheses we do an investigation in the concention of and attitude towards technology of 13 year old students.
As a first step we interviewed 12 students, asking them questions such as: what do you think technology is, how important is technology for you?
Secondly, we asked 48 pupils of two different schools to write down their ideas about technology, answering 10 open-ended questions we offered them.
The answers we got in both steps were used to construct a questionnaire consisting of 80 questions to be answered in a 5 point Likert-scale. The questions could be divided in 8 sections: general knowledge of technology, interest, importance etcetera. To avoid misunderstanding: the questions in the questionnaire were not grouped in these sections; they were offered in a mixed order.
The questionnaire was offered to some 3,000 13 year old pupils of different types of schools in different parts of the country.

The results were factor-analysed. 20 factors were found of which 14 could be identified. Factor scores were computed and the differences between girls and boys were tested for significance.
Conclusions are that it is difficult for pupils to indicate what technology is. They are aware of the importance and the diversity of technology.
Girls are less interested in technology than boys are.
Girls as well as boys think that girls are not for technology.

To have first possibilities to compare the results with other countries a translation of the same questionnaire is offered at Polish pupils of the same age. There is a correspondence with investigators in Hungary, USA, UK, Canada, Australia, Nigeria to do the same.
First results of a pilot study will be discussed in an workshop at the Eindhoven University of Technology.

Student's attitude towards technology

The conception of and the attitude towards technology of 13-year-old girls (and boys).

1. Introduction

The investigation reported here, is part of the project *Physics and Technology*.

In the project *Physics and Technology* we try to find out how attention can be paid to technology in secondary schools for general education. We do this in the framework of technology as part of the physics-curriculum. At the present moment "technology" is not yet a separate subject in the curriculum of these schools.

But at age 13-15 pupils have to make choices concerning their further education and future profession, including choices in relation to technological studies and professions. How do they get information about technology? What conception of technology determines their choices?

An important question is whether or not girls and boys have different conceptions of technology. From experience obtained in the MENT-project with respect to the relation "girls and physics" we expect 13-year-old girls to have a vaguer notion of technology than boys, and a less positive attitude towards it (Lemsink 1983). If that is indeed the situation, it is important to try and change it. In teacher education attention should be paid to this (Raat, 1983).

We are interested in finding out whether the profession of the parents of the pupils (for girls: expecially the mother's profession) affects the pupil's attitude towards technology.

To find an answer to these questions we have investigated the conception of and attitude towards technology of 13-year-old pupils in secondary schools (in Holland).

2. The attitude-measurement

Our measurement consisted of the following steps:

1. To start with we interviewed 12 pupils of ages 13-14. We asked them questions such as:
- what do you think of when I use the word "technology";
- do you think technology is important for you;

- what are you told about technology at school;
- do you think technology has good or bad consequences;
- can you mention some technological professions?

The aim of these interviews was to find out how pupils talk about technology, what words they use, what ideas they have about it.
For the same reason we also asked 48 pupils of the same age to answer 10 open(-ended) questions on paper. These questions were the same as the questions used in the oral interviews.

2. On the basis of the results of the interviews and the open questions we formulated 82 statements about technology and added a 5-point Likert-scale to them.

Some examples of these statements are:

- technology is very important in life;
- technology is nothing for girls;
- for pupils of my age technology is not interesting;
- I would like to work in technology later.

This questionnaire was meant as a try-out version.
The questions can be divided into 8 sections:
general knowledge of technology, interest in technology, importance of technology, girls and technology, technological professions, difficulty of technology, creativity in technology, good or bad consequences of technology.
The questions were presented in random order.
After 248 pupils had answered the questions the list was factor-analysed.

3. With the results of the statistical analysis of the first list as a basis we were able to compile the definite version of the attitude-l
This version was presented to 2,631 pupils in the second form of general secondary schools (there were 1,385 girls and 1,246 boys).
A stratified sample was taken: different parts of the country, different types of schools were chosen: small and big, in rural and industrial areas, private and state-supported schools.
Appendix 1 is the definite version of the questionnaire.

4. This definite version was analysed statistically and conclusions were drawn from the results.

5. To get some illustrative material in the attitude-measurement (also to be used to investigate the validity of the results) we asked some 100 pupils to write a short composition about one of the following questions:
- what I think of technology,
- if I would work in technology,
- technology in everydays' life,
- what I would like to learn about technology.

Another 100 pupils were asked to give a short scriptural answer to the following questions:
- give a short description of "technology",
- do you think you have to be creative for technology,
- do you think technology is something for girls as well as for boys,
- what is the difference between physics and technology?

Finally, some 500 pupils were asked to indicate whether or not 36 various subjects belong to technology (e.g.: a computer, a sailing ship, a coffee maker, making a dress) and whether or not 26 professions are technological (e.g.: a car mechanics, a cook, a dentist, a greengrocer, a computer).

3. Results

A. The interviews and open-ended questions

Many pupils were not able to make explicit their notion of technology. They can mention a great many different technological appearances, but it is very hard for them to give some definition of technology. Some pupils don't think they have much involvement with technology. Other pupils can mention a lot of instances of everyday-life technology. Most of them mention the computer as an important aspect of technology. The majority of both the boys and the girls profess to be interested in technology. This confirms earlier investigation in interest of secondary students in technology (Weltner, 1980). Nearly all pupils say technology is important for society. It is difficult for many pupils to say what is good and what is bad about technology. Many pupils find it difficult to distinguish two meanings of the word "technics" (for technology and technique: the same word is used in Dutch): 1. the way you do something (play the piano technically well) and 2. technology. One of the consequences of this fact was that a foreword was included to the questionnaire in which we indicate that the first meaning is not what we want the pupils to give their opinion about. We gave no further indication about what we meant by "technology".

We decided not to compare the results for girls and boys in the interviews and open-ended questions because 1. only few pupils were involved and 2. this was not the object of this pilot study. In the results of the final analysis the differences between girls' and boys' attitude towards technology will be described.

B. Analysis of the try-out version of the questionnaire

This analysis consists mainly of a factor analysis (principal factor with iterations followed by varimax rotation) of the 82 questions. As a result 15 factors were found.

The coefficient of homogeneity (coefficient alpha) was 1.81 which is sufficient for this try-out version.
After the analysis 7 questions with low item-total correlation and low factor loadings were omitted and 3 questions about developing countries were added, so that the final version of the list contains 78 items.
For the same reasons as in the interviews and open-ended questions we did not compare the results for girls and boys in the try-out version of the list.

C. Analysis of the definite version of the questionnaire

Factor-analysis of the definite version of the questionnaire yielded 20 factors, of which 14 could be identified. The other factors had to few items to give them a name that makes sense.
The first 14 factors were these:

1. 17 items about interest in technology.
2. 8 items about girls and technology.
3. 7 items about the diversity of technology.
4. 7 items about the importance of technology.
5. 4 items about being acquainted with technology.
6. 4 items about girls and repairing.
7. 4 items about creativity and technology.
8. 3 items about school and technology.
9. 3 items about the difficulty of technology.
10. 2 items about developing countries and technology.
11. 2 items about the importance of technology, but other items than in factor 4.
12. 1 item about the choice of technical professions.
13. 2 items about the diversity of technology, but other items than in factor 3.
14. 2 items about working with your hands in technology.

Only the first few factors are important for the attitude. Factors 1-7 declare 76% of the variance.
In appendix 2 the items of the questionnaire that belonn to a factor are put together for the first 14 factors.
The numbers after the items are the factor-loadings for the item on the factor.

For each factor factor-scores of the girls and boys were computed and differences were tested for significance (t-test, two-tailed, level of significance: 0.05).
For factor 1-14 the homogeneity coefficient alpha was computed for the items with factor loadings higher than 0.30.
The results are:
factor 1: alpha = 0.90 (17 items)
factor 2: alpha = 0,72 (8 items)
factor 3: alpha = 0.58 (7 items)
factor 4: alpha = 0.62 (7 items)
factor 5: alpha = 0.58 (4 items)
factor 6: alpha = 0.57 (4 items)
factor 7: alpha = 0.47 (4 items)
factor 8: alpha = 0.52 (3 items)
factor 9: alpha = 0.47 (3 items)
factor 10: alpha = 0.49 (2 items)
factor 11-14: alpha smaller than 0.30.
We conclude that the homogeneity is sufficient for factor 1-10.

4. Conclusions

A. General conclusions from the results of the questionnaire

By inspecting the scores of the pupils on the items and the factors to which the items belong the following conclusions can be drawn:
- there are great differences in interest between girls and boys. Boys are interested in technology and girls are rather neutral,
- boys as well as girls think that girls are apt for technology, and that girls should be able to repair things themselves,
- pupils have a broad image of technology: technology is not only concerned with computers or electricity,

- nunils think that technolony is imnortant in daily life and it is aood for our society an for develonina countries,
- nunils are not very acquainted with technical annaratusses such as a car or a coffee-maker,
- nunils are not very aware of the imnortance of creativity and desionina in technolony,
- nunil think they do not hear much about technolony at school and they would like to learn more about it,
- they think technolony is not very difficult for them,
- they think it difficult to say whether or not they would like to havo a technical nrofession,
- the relation between nhysics and technolony is not clear to nunils.

B. Differences between girls and boys

At a number of factors scores of girls and boys differ sionificantly. The differences are:

- girls are less interested in technoloay than boys are (have a lower factor score on factor 1),
- girls have more confidence in girls' antitude for technolony than boys have (have a hiaher score on factor 2),
- girls have a less broad imaae of technolony than boys have (have a lower score on factor 3),
- girls are less aware of the imnortance of technoloay than boys are (have a lower score on factor 4),
- girls are less aquainted with technoloay than boys are (have a lower score on factor 5).

C. Influence of the narents' nrofession

Factor scores of nupils with a father or a mother who has a technical nrofession were comnared with scores of nunils with a father or a mother who had no technical nrofession. The sianificant differences are:

"- nunils with a technical father or mother are more acnuainted with technolony and are more aware of the imnortance of technoloay."

D. Some results of the additional questionnaires (mentioned on p. 4)

1. Although in the introduction of the Likert-questionnaire a remark is made about technology not being "the way you do something", it is possible that some pupils still answer the items with that conception of technology in their minds. To see how many pupils do that we asked them in one of the additional questionnaires to give a short description of technology (in the introduction of this questionnaire the same remark about "the way you do something" is made). About 10 % of the pupils still gave an answer like "the way you do something". So we have to assume that about 10 % of the pupils that answered the Likert-questionnaire were thinking of "the way you do something".
2. Neither girls nor boys can indicate why they think girls can do technology as well as boys. They do not know a girl of woman who works in technology.
3. The difference between physics and technology is not clear to pupils.
   Some misconceptions are:
   - in physics you do experiments, in technology you don't (about 25 % of the answers),
   - physics is only concerned with nature, technology is only concerned with apparatusses (about 25 % of the answers),
   - about 25 % of the pupils can not indicate the difference or say that there is no difference.

E. Summary of the results

We summarize the results:
Punils think that technology is a broad, important, not too difficult subject, but it is hard for them to say what it is and why it is not the same as physics.
They are not aware of the importance of creativity and designing for technology.
They would like to hear more about it at school. Now they do not hear enough about it to say whether or not they would like to have a technical profession.
Differences between girls and boys are: girls are less interested, have more confidence in the aptitude of girls for technology, are less aware of the diversity of techology and are less acquainted with technical objects.
Punils with a technical father or mother are more acquainted with technology and are more aware of the importance of technology.

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5. Further research and international cooperation.

a. The attitude-measurement is part of the project "Physics and Technology". Another part of this project is the development of some lesson-material for physics in which technology plays an essential role. For the authors of this material it is important to know how pupils feel about technology so the results of the attitude-measurement are used in the development of the lesson-material.
Special attention is to be paid to the way in which this material can be made attractive to girls. The results of the questionnaire may yield important information on this point.

b. Because of the good statistical properties of the questionnaire it may be used in other forms of the secondary general school and in other secondary (professional) schools as well.

c. In order to compare our results with those obtained in other countries there is a correspondence with investigators in Poland, Hungary, U.S.A., U.K., Canada, Australia, Nigeria. These contacts can function as a pilot-study for further international investigation.

In each country an English version of the questionnaire will be filled in bij some 200 13 year old pupils in general education. Results of this pilot study will be discussed at a workshop, to be held at Eindhoven, spring '86.

Literature

Lensink, M., *Girls, Physics and technology in The Netherlands, the HENT-project* in: Contributions to the second GASAT conference, University of Oslo, Oslo, 1983; p. 183.

Raat J.H., *Teacher training towards a better girls' science and technology education*, in: Contributions to the second GASAT conference, University of Oslo, Oslo, 1983; p. 302.

K. Weltner and others, *Interest of Intermediate-Level Secondary Students in Physics and Technology*. Europ. J. Sci. Educ. 2(1980), 183-189.

Appendix 1 Mean scores and standard deviations

QUESTIONNAIRE

for pupils

about

TECHNOLOGY

This is the definite version of the Likert-questionnaire.* Next to the items the scores of the pupils are given in percents. Also the mean score and the standard deviation are given for each item.

* This is a translation of the Dutch text.

In the newspapers you often read things about technology. You can also watch many T.V.-programmes about technology.

In this questionnaire we want to ask you what <u>your</u> opinion about technology is. Please, answer the questions and let us know what you think of technology.

This questionnaire contains 78 statements. You should indicate whether you agree or not.

An example:

	strongly agree	agree	undecided	disagree	strongly disagree
Mathematics is very interesting	1	2	3	4	5

If you strongly agree, put a circle around answer 1 (like this: ①)
If you agree, but you hesitate, put a circle around answer 2 (②)
If you are undecided, put a circle around answer 3 (③)
If you disagree, but you hesitate, put a circle around answer 4 (④)
If you strongly disagree, put a circle around answer 5 (⑤).

GIVE YOUR OWN OPINION

DON'T THINK TOO LONG ABOUT A STATEMENT

THE RESULTS ARE WORKED OUT ANONYMOUSLY; YOU DON'T HAVE TO GIVE YOUR NAME

IT IS IMPORTANT TO ANSWER ALL THE QUESTIONS ON PAGE 2

Thank you very much for your help !

Please, answer these questions first:

What is your age :
Are you a girl or a boy :
What is your class :
What is the name of your school :

Describe the occupation of your father (what he does, where he works):

Do the same in respect of your mother:

On the next page the statements begin.

1. Technology is very important in life.	37	52	9	2	0	1.78	0.
2. Technology makes everything go better than before.	42	41	9	7	1	1.86	0.9
3. Technology is only concerned with computers	0	1	5	41	52	4.44	0.8
4. When something new is discovered, I want to know more about it immediately.	9	23	28	30	9	3.07	1.1
5. Working in technology is very creative.	13	40	34	9	3	2.49	0.9
6. Girls cannot do technology.	4	2	6	27	62	4.41	0.9
7. I positively do <u>not</u> want to have a job that in technology.	6	6	39	24	25	3.56	1.1
8. Developed countries can do much for developing countries by technology.	32	43	17	6	2	2.04	0.9
9. Technology is good for the economy.	17	37	36	7	2	2.40	0.9
10. I have never used a screw-driver.	11	5	1	12	72	4.29	1.3
11. In everyday life you do <u>not</u> have much to do with technology.	3	6	10	43	38	4.06	1.0
12. In technology you have many opportunities to use your imagination.	15	35	33	12	5	2.57	1.0
13. Technology is too difficult for me.	4	6	28	38	24	3.71	1.0
14. A girl can have a technological profession just as well as a boy.	66	22	4	3	5	1.60	1.0
15. All jobs have something to do with technology.	8	26	26	28	12	3.11	1.1
16. In technology you have to design things by yourself.	4	18	43	28	8	3.18	0.9
17. For pupils at my age technology is <u>not</u> interesting.	3	4	20	36	38	4.02	0.9
18. I know pretty well how a coffee maker works.	42	33	7	11	6	2.06	1.2
19. In the newspaper you often read about technology.	22	44	25	7	2	2.23	0.9
20. Without technology there would be more problems in the world.	31	33	22	9	6	2.25	1.1
21. Boys are able to repair things better than girls.	7	13	10	31	39	3.83	1.2
22. You do <u>not</u> have to be creative to work in technology.	6	24	39	24	7	3.01	1.0
23. To understand something of technology you have to take a difficult training course.	4	15	26	38	17	3.48	1.0
24. A hundred years ago there was <u>no</u> technology.	4	6	29	32	29	3.74	1.0

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	strongly agree	agree	undecided	disagree	strongly disagree	mean score	st. dev.
25. I would like to learn more about technology at school.	27	34	16	16	8	2.43	1.25
26. Developing countries should develop their own technology.	9	24	21	29	17	3.21	1.23
27. It is a good thing when girls learn to put a plug on a cord.	36	36	13	8	6	2.12	1.18
28. Technology gives people more leisure.	18	31	33	13	6	2.59	1.10
29. It is difficult for me to say now whether or not I want to choose a technological profession.	30	35	13	11	12	2.40	1.32
30. There should be more T.V.-broadcastings about technology.	13	24	24	25	14	3.03	1.26
31. To know how a bike is constructed you do not have to study technology.	27	31	16	18	8	2.50	1.29
32. Thoughts of technology are not often in my mind.	19	32	11	25	13	2.82	1.35
33. Technology has brought more good things than bad things.	17	29	38	10	6	2.59	1.07
34. If you know nothing about technology, you are behind the times.	9	21	20	31	19	3.39	1.24
35. Girls prefer not to go to a technical school.	10	24	28	21	17	3.10	1.23
36. At school I hear enough about technology to be able to make a choice about going or not going to a technical school.	4	15	26	38	18	3.50	1.07
37. In technology there are not much inventions that are really new.	3	11	40	29	18	3.47	1.01
38. If there was a hobbyclub about technology at school, I would certainly join it.	12	15	38	21	15	3.12	1.18
39. Technology is good for developing countries.	29	44	21	4	2	2.06	0.91
40. I do not know what the word "technology" includes.	8	18	11	43	21	3.52	1.21
41. Humans can not do without technology.	24	42	20	12	3	2.29	1.06
42. Technology is always bad for the environment.	8	16	29	36	11	3.26	1.11
43. Boys know more about technology than girls do.	9	21	17	26	28	3.44	1.32
44. I would like to work in technology later.	15	21	38	14	11	2.84	1.18
45. Designing an appliance is not a part of technology.	1	3	19	39	38	4.08	0.90

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46. I am not interested in technology.	9	12	12	36	31	3.68	1.2
47. At school you do not hear much of technology.	12	42	13	24	4	2.54	1.0
48. With technology you learn to assemble appliances m.	11	41	29	16	4	2.60	1.0
49. I think technology is a bit scary.	2	6	13	35	43	4.10	1.0
50. I know how most appliances are constructed.	6	21	15	38	21	3.46	1.1
51. More girls should go to a technical school.	21	39	31	11	7	2.53	1.1
52. Technology makes people ask for more and more comfort.	21	33	39	5	2	2.34	0.9
53. When I choose a profession I do not consider whether or not it is technological.	11	23	25	25	16	3.11	1.2
54. I like to read technological magazines.	11	17	12	32	28	3.51	1.3
55. Making a dress is a sort of technology.	12	40	27	13	9	2.66	1.1
56. Technology is the subject of the future.	30	38	24	6	2	2.11	0.9
57. Technology is as difficult for girls as it is for boys.	48	29	12	7	4	1.91	1.1
58. I enjoy repairing things at home myself.	36	36	7	15	6	2.19	1.2
59. Technology is: working a lot with your hands.	22	45	17	13	3	2.31	1.0
60. You must be very clever to be able to study technology.	5	17	23	39	17	3.47	1.1
61. A girl had better not become a car mechanic.	4	5	9	29	53	4.20	1.0
62. Technology always has to do with electricity.	2	8	18	46	26	3.84	0.9
63. Modern technology should be adapted before being applied in developing countries.	15	29	43	9	5	2.60	1.0
64. At school you should learn more about repairing things around the home.	33	36	12	14	4	2.19	1.1
65. You can learn a lot of technology by yourself.	30	53	14	3	1	1.92	0.7
66. Mothers should be able to repair domestic appliances themselves.	21	34	21	16	7	2.53	1.1
67. At school you never hear anything about technological jobs.	6	19	23	42	10	3.30	1.0
68. In technology there is not much opportunity to invent things by yourself.	3	7	40	33	17	3.55	0.9
69. It would have been better if no technological inventions would had ever been made.	3	3	16	25	44	4.15	0.9

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70. I know what most appliances are for.	14	34	12	25	14	2.91	1.31
71. Girls should repair their own bicycle-tires.	49	35	5	6	5	1.83	1.10
72. Technology makes people more creative.	14	33	41	9	3	2.54	0.94
73. I cannot mention many technical jobs.	4	17	15	41	27	3.59	1.14
74. Technology is only for bright people.	2	2	8	32	55	4.37	0.88
75. Technology mostly is not dangerous.	4	11	31	39	15	3.49	1.04
76. Sometimes I have taken things apart to see how they work.	41	35	4	13	9	2.14	1.35
77. Technology is nothing but applied physics	5	13	60	17	7	3.08	0.87
78. These sort of questions about technology are difficult for me.	16	20	12	31	21	3.19	1.42

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Appendix 2. Factors and their items

In this appendix the items that belong to a factor are put together. Next to the items there factor loading on the factor is given.
Sometimes items with a loading smaller than 0,30 are included. These were not included in the calculation of the homogeneity coefficient.

Factor 1. Interest in technology	factor loading
44. I would like to work in technology later.	0.79
38. If there came a hobbyclub about technology at school, I would certainly join it.	0.74
46. I am not interested in technology.	0.74
25. I would like to learn more about technology at school.	0.73
54. I like to read technological periodicals.	0.70
30. There should be more T.V.-broadcastings about technology.	0.70
32. I do not think a lot about technology.	0.63
7. I positively do not want to have a job that has to do with technology.	0.62
58. I like to repare something at home myself.	0.60
4. When something new is discovered, I want to know more about it immediately.	0.47
64. At school you should learn more about pottering and repairing.	0.46
76. Sometimes I have taken something apart to see how it works.	0.46
13. Technology is too difficult for me.	0.39
50. I know how most annaratusses are constructed.	0.35
40. I do not know what the word "technology" contains.	0.33
78. This sort of questions about technology are difficult for me.	0.32
70. Of most parts of a car I know what they are meant for.	0.31
1. Technology is very important in life.	0.29
73. I cannot mention many technical jobs.	0.29
5. Working in technology is very creative.	0.29
17. For pupils at my age technology is not interesting.	0.27
65. You can find out a lot of technology by yourself.	0.27
53. When I choose a profession I do not consider whether or not it is technological.	0.25

Factor 2. Girls and technology	factor loading
21. Boys are able to repare things better than girls.	0.70
61. A girl had better not become a car mechanic.	0.64
43. Boys know more about technology than girls do.	0.64
57. Technology is as difficult for girls as it is for boys.	0.57
6. Technology is nothing for girls.	0.56
14. A girl can have a technological profession just as well as a boy.	0.47
35. Girls prefer not to go to a technical school.	0.43
51. More girls should go to a technical school.	0.30

Factor 3. Diversity of technology	
3. Technology is only concerned with computers	0.47
24. A hundred years ago there was no technology.	0.42
45. Designing an apparatus is no part of technology.	0.38
62. Technology always has to do with electricity.	0.38
40. I do not know what the word "technology" contains.	0.32
65. You can find out a lot of technology by yourself..	0.31
68. In technology there is not much opportunity to invent things by yourself.	0.30
69. It would have been better if no technological inventions would have been made.	0.29
73. I cannot mention many technical jobs.	0.28
42. Technology is always bad for the environment.	0.27
49. I think technology a bit weird.	0.26

Factor 4. Importance of [illegible]	factor loading
20. Without technology there would be more problems in the world.	0.54
2. Technology makes everything go better than before.	0.51
41. Man can not do without technology.	0.50
69. It would have been better if no technological inventions would have been made.	0.39
33. Technology has brought more good things than bad things.	0.35
9. Technology is good for the economy.	0.31
39. Technology is good for developing countries.	0.30
1. Technology is very important in life.	0.29

Factor 5. Acquaintance with technology

50. I know how most apparatusses are constructed.	0.55
70. Of most parts of a car I know what they are meant for.	0.49
18. I know pretty well how a coffee maker works.	0.38
76. Sometimes I have taken something apart to see how it works.	0.33

Factor 6. Girls and repairing

66. Mothers should be able to repare domestic apparatusses themselves.	0.51
71. Girls should repare their own bicycle-tires.	0.47
27. It is a good thing when girls learn to put a plug on a cord.	0.45
51. More girls should go to a technical school.	0.31

Factor 7. Creativity and technology	factor loading
5. Working in technology is very creative.	0.50
72. Technology makes people more creative.	0.47
12. In technology you have many opportunities to use your fantasy.	0.36
22. You do not have to be creative to work in technology.	0.32
16. In technology you have to design things by yourself.	0.22
59. Technology is: working a lot with your hands.	0.22

Factor 8. School and technology	
47. At school you do not hear much of technology.	0.63
67. At school you never hear something about technological jobs.	0.55
36. At school I hear enough about technology to be able to make a choice about going or not going to a technical school.	0.42

Factor 9. Difficulty of technology	
60. You must be very clever to be able to study technology.	0.47
74. Technology is only for learned people.	0.43
23. To understand something of technology you have to take a difficult training course.	0.38

Factor 10. Developing countries and technology	
39. Technology is good for developing countries.	0.50
8. Developed countries can do much for developing countries by technology.	0.50
63. Modern technology should be adapted before being applied in developing countries.	0.21

Factor 11. Importance of technology (2)	Factor loading
28. Technology gives people more leisure.	0.36
77. Technology is nothing but applied physics	-0.31
52. Technology makes people more exacting.	0.26
34. If you know nothing about technology, you are behind the times.	0.26
56. Technology is the subject of the future.	0.25

Factor 12. Choice of technical profession	
29. It is difficult for me to say now whether or not I want to choose a technological profession.	0.45
32. I do not think a lot about technology.	0.27
53. When I choose a profession I do not consider whether or not it is technological.	0.26

Factor 13. Diversity of technology (2)	
15. All jobs have something to do with technology.	0.42
55. Making a dress is a sort of technology.	0.42

Factor 14. Working with your hands in technology	
48. With technology you learn to assemble apparatusses	0.36
59. Technology is: working a lot with your hands.	0.25

Appendix 3 International cooperation

THE INTERNATIONAL PILOT STUDY

Participants in the international pilot study are asked to give the version of the questionnaire the 78 items on the pages 17-20 of this paper to some 200 13-year old pupils in general education. When english is not the first language then first the list of items has to be translated.

If you want us to proceed the answers by computer, please send us the filled in questionnaires. You will receive the results as soon as possible.

If you are able to proceed the results by yourself, please send us:
-the means and standard deviation of the scores on the 78 items,
-the inter-item correlation of each item,
-the item-total correlation of each item,
-the homogeneity coefficient alpha of the questionnaire,
-the outcome of a factor analysis of the questionnaire (principle component method with iterations).
If SPSS programmes are available to you, you can use the programmes ABFREQ, RELFREQ, MEAN STDEV, RELIABILITY (with statistics 1,2,4,5,8,9) and FACTOR (with statistics 4,5,6,7).

We hope that we will receive your results before nov. 1, 1985.

We will send you before jan. 15, 1986:
-first results,
-our ideas about further steps,
-an invitation for a workshop to be held at Eindhoven, spring 1986 (first part of march -?-).

If there are questions, please contact us.

Jan H.Raat
Marc de Vries

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